

5 CROSS-REFERENCE TO RELATED APPLICATIONS

10 BACKGROUND OF THE INVENTION

The present invention encompasses a joining clip for joining together insulated concrete form systems in either a horizontal or vertical dimension, or both, such as a U-shaped joining clip removably attached to welded wire form ties in insulated concrete forms, insulated concrete form systems so joined together using joining clips, and methods for constructing insulated concrete form walls using joining clips.

Note that the following discussion refers to a number of publications by author(s) and year of publication, and that due to recent publication dates certain publications are not to be considered as prior art vis-à-vis the present invention. Discussion of such publications herein is given for more complete background and is not to be construed as an admission that such publications are prior art for patentability determination purposes.

Traditional concrete walls in building construction are generally made by setting up two parallel form walls and pouring concrete into the space between the forms. After the concrete hardens, the builder then removes the forms, leaving the cured concrete wall. This common prior art technique has significant drawbacks. The resulting wall is not insulated, and significant labor is required to both place the forms prior to pouring concrete and to remove the forms after the concrete cures or hardens.

Techniques have developed for forming modular concrete walls that use a foam insulating form material, generally referred to as "insulated concrete forms" or by the acronym "ICF". Using modular forms, which are available in different sizes, walls are set up. Most insulated concrete forms are composed of two parallel panels, forming an exterior and interior wall panel, with ties, bridges or other connecting components, generally called "ties", holding the two panels in place relative to each other while concrete is poured into the cavity between the panels. The insulated form panels remain in place after the concrete cures. Thus no labor is required to either remove forms or add insulation, resulting in substantial efficiency. In most cases, the insulation of the form provides adequate insulation for the building, so that no additional insulation is required.

Insulated concrete forms are manufactured from a polymeric material, often polyurethane or polystyrene, which expands within a mold to yield a rigid, low-density foamed plastic form having vertical and/or horizontal cavities to be filled with wet concrete. U.S. Patent No. 3,552,076, entitled *Concrete Form* to Gregori, and U.S. Patent No. 3,788,020, entitled *Foamed Plastic Concrete Form With Fire Resistant Tension Member*, also to Gregori, are two early patents that both teach methods whereby polystyrene foam is molded to yield a concrete form. Other patents disclosing such forms include U.S. Patent No. 4,879,855, entitled *Attachment and Reinforcement Member for Molded Construction Forms*, to Berrenberg.

A series of concrete forms and form systems are made and sold by American Polysteel, LLC, with a representative form as shown in FIG. 9. As shown in FIG. 9, this is a waffle grid form, and is sold by American Polysteel under the PS-3000 Series name. These forms and form systems utilize a welded wire tie system for securing the opposing panels of expanded polystyrene to each other.

Other ICF concrete forms are made and sold by other manufacturers. All or virtually all forms employ some type of tie, typically made of plastic or a polymeric material, used to secure opposing panels of the forms.

To use ICF concrete forms, the forms are stacked in an appropriate configuration, and concrete is then poured into the cavities of the forms (FIG. 9), forming either a planar wall (as in the case of a flat panel form) or a waffle grid wall (as in the case of a waffle grid form). To increase the stability of the wall during the concrete pouring process, and to prevent blow-out (rupture or movement of forms

permitting the escape of concrete), the forms are typically glued or secured with other adhesives along the joining seam lines. This approach, while satisfactory in terms of the integrity of the resulting structure, has a number of substantial and significant drawbacks. First, laying a glue line on both sides of a form along all joints is labor intensive. Second, the glue or adhesive employed is expensive. Third, most suitable adhesives can only be applied under certain environmental conditions; for example, the temperature must be above freezing, and frequently above about 50° F., the surfaces must be dry, which limits use during inclement weather, and so on. Fourth, most suitable adhesives are extremely adhesive and are not soluble in water or ordinary solvents, and thus cannot be removed from clothing or other surfaces. All of these factors, and related and other factors known to those of skill in the art, present substantial and significant drawbacks.

U.S. Patent No. 4,730,422 to Young, dated March 15, 1988, discloses a synthetic plastic concrete wall tie comprising a pair of triangular truss sections disposed in an end-to-end relation, t-shaped end sections, the cross-piece of the t-shaped end section designed to anchor the tie to a slotted wall section. This tie is used to connect opposing wall panels (modular foam panels), thereby allowing concrete to be poured. This tie also allows for external fasteners to be screwed into the concrete wall by providing a place to anchor those fasteners. This tie acts in a similar manner to the welded wire tie system for securing the opposing panels of expanded polystyrene to each other. This tie is not a joining clip to secure insulated forms together in a vertical and/or horizontal plane.

U.S. Patent No. 5,454,199 to Blom et al., dated October 3, 1995, discloses a wall clip to provide a nailing or securing surface or stud for receiving fasteners of finishing material. The clips are anchored at the top and bottom of the concrete form, and are external to the form. While these clips to provide some structural benefit to the wall, they are external to and are not used to connect insulated forms in a vertical and/or horizontal configuration.

U.S. Patent No. 5,509,636 to Cotugno, dated April 23, 1996, discloses a retainer clip for notched form ties for retention of reinforcing rods. This device can be used to replace the wire ties to connect two form panels together, prior to filling with concrete. This device might be used in conjunction with the present invention, but does not serve the function of interiorly connecting concrete panel forms in a vertical and/or horizontal configuration.

U.S. Patent No. 5,881,460 to Nowell, III et al., dated March 16, 1999, discloses a device and method for fastening concrete reinforcement steel members such as rebar or wire mesh in a grid configuration. These clips are a deformable metal fastener and connect grid systems together prior to placement in a concrete form (e.g. a concrete slab for a home) or while in the concrete form. This device is not a joining clip for connecting concrete panel forms.

U.S. Patent No. 5,937,604 to Bowron, dated August 17, 1999, discloses a concrete form wall spacer shaped like a truss, used between the spaces of concrete form walls and which anchors the walls against the abutments on the framework. These spacers also have rebar supports and allow for the footing and wall to be tied together.

There thus remains a need in the industry for a method and device to join adjacent insulated concrete forms in either the horizontal or vertical dimensions, and preferably both, so as to provide superior structural strength and integrity while pouring concrete, without the use of glues or adhesives. There further remains a need in the industry for more cost effective methods and devices of joining insulated concrete forms one to another to maintain structural integrity while pouring concrete and while the concrete cures.

BRIEF SUMMARY OF THE INVENTION

In one embodiment, the invention provides a joining clip in combination with at least two insulated concrete forms with first and second substantially opposing panels and a plurality of ties interconnecting the first panel and the second panel, wherein the joining clip constitutes a positive connection between immediately adjacent ties of at least two contiguous insulated concrete forms. The joining clip may provide a horizontal connection between horizontally adjacent insulated concrete forms or a vertical connection between vertically adjacent insulated concrete forms. In the combination, the ties can constitute an interconnecting member to which the joining clip may be removably fastened in both a vertical and horizontal orientation. In one preferred embodiment, the ties are wire ties. In another preferred embodiment, the joining clip includes a metal wire bent in a U-shape forming two parallel legs with a first open end and a second closed end, with at least one of the first open end and second closed end formed in an acute angle for engaging about a portion of a tie. Preferably, both the

first open end and second closed end are formed in an acute angle for engaging about portions of immediately adjacent ties. The joining clip may be formed of mild steel or a metal alloy. Alternatively, the joining clip may be a metal strap, metal wire or plastic strap. Where the joining clip is U-shaped as described, the wire may include a circular, rectangular or irregular cross-section. The joining clip
5 preferable at least partially engages, and more preferably fully engages, about a portion of the immediately adjacent ties. In one embodiment of the combination, the joining clip has an elongated structure with a first end and a second end, each of the first end and second end being formed to define an acute angle for engaging about at least a portion of the immediately adjacent ties. Where the joining clip is U-shaped, the joining clip legs and the ties to which the joining clip is attached may define
10 a bounded area for receiving and restraining a reinforcing rod.

In another embodiment, the invention provides a joining clip adapted for joining together two or more insulated concrete forms with first and second substantially opposing panels and a plurality of ties interconnecting the first panel and the second panel, the joining clip including a U-shaped bent wire with substantially equal length and parallel legs and a first open end and second closed end, the first open
15 end being bent to form a first acute angle for engaging a portion of a tie, and the second closed end being bent to define at least a portion thereof forming a second acute angle for engaging a portion of a tie, wherein the length of that portion of the joining clip between the first acute angle and the second acute angle is approximately equal to a distance between coplanar ties in immediately adjacent vertically arrayed insulated concrete forms or between immediately adjacent ties in horizontally arrayed
20 insulated concrete forms.

In another embodiment, the invention provides a method of fastening insulated concrete forms one to another, including the steps of:

providing a U-shaped joining clip with two approximately parallel legs and a first open end and second closed end, the first open end and second closed end being formed to define an acute
25 angle;

positioning at least a first and second insulated concrete form with ties immediately adjacent one to another in either a horizontal or vertical configuration;

securing one end of the joining clip to a first insulated concrete form by engaging the portion thereof defining an acute angle about a portion of a tie; and

securing the remaining end of the joining clip to the second insulated concrete form by engaging the portions thereof defining an acute angle about a portion of an immediately adjacent tie of the second insulated concrete form.

In the method, securing of forms can preferably further include secure containment of poured concrete between the at least two insulated panels without seepage of concrete. In another embodiment of the method, at least three insulated concrete forms are provided arrayed in both a horizontal and vertical configuration, the method further including joining the at least three forms in both a horizontal and vertical orientation.

A primary object of the present invention is to provide a device and method for joining insulated concrete forms one to another in a horizontal or vertical dimension, and preferably both.

A primary advantage of the present invention is that it provides a method and device for joining insulated concrete forms one to another without the use of glues, adhesives, tape or other similar materials.

Other objects, advantages and novel features, and further scope of applicability of the present invention will be set forth in part in the detailed description to follow, taken in conjunction with the accompanying drawings, and in part will become apparent to those skilled in the art upon examination of the following, or may be learned by practice of the invention. The objects and advantages of the invention may be realized and attained by means of the instrumentalities and combinations particularly pointed out in the appended claims.

BRIEF DESCRIPTION OF THE SEVERAL VIEWS OF THE DRAWINGS

The accompanying drawings, which are incorporated into and form a part of the specification, illustrate one or more embodiments of the present invention and, together with the description, serve to explain the principles of the invention. The drawings are only for the purpose of illustrating one or more preferred embodiments of the invention and are not to be construed as limiting the invention. In the drawings:

FIG. 1 is an angled view of a joining clip of the invention;

FIGS. 2 and 3 are alternative views of joining clips of this invention;

FIG. 4 is an illustration of a top view of a joining clip of this invention connecting two insulated concrete forms in a horizontal configuration;

5 FIG. 5 is an illustration of a joining clip of this invention connecting two insulated concrete forms in a vertical configuration;

FIG. 6 is an illustration of a joining clip of this invention employed to join together two angled insulated concrete forms in a horizontal configuration;

10 FIG. 7 is an illustration of a joining clip of this invention employed to join together insulated concrete forms in both a horizontal and vertical configuration;

FIG. 8 is an illustration of an alternative joining clip of this invention employed to join two insulated concrete forms; and

FIG. 9 is an illustration of an American Polysteel, LLC insulated concrete form partially filled with concrete.

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DETAILED DESCRIPTION OF THE INVENTION

Insulating concrete forms generally consist of two parallel and opposing panels of expanded polystyrene (EPS) tied together with a form "tie" of either steel or plastic. The foam panels are either molded around these ties, so that the ties become an integral part of a molded EPS form, or
20 alternatively the ties are separate pieces used to assemble two independently formed or cut panels of foam in the field as walls are being formed.

The three key functions of the form ties in insulating concrete forms are: (1) to maintain the integrity of the form during the placement of concrete by preventing the foam panels from deforming or separating, (2) to provide ample space for concrete to flow through and around the tie to facilitate the
25 formation of a solid concrete wall, and (3) to provide a secure surface for the mechanical attachment of interior and exterior wall coverings. Applicant has discovered that form ties can serve a fourth function; by use of joining clips of this invention discrete forms may be interconnected, one to another, in either or both vertical or horizontal orientations, such that the multiple insulating concrete forms are tied together,

to form a single unit. This advantageously maintains structural integrity of the insulated concrete form wall while concrete is being poured and cures.

As depicted in FIGS. 1 to 3, in one preferred embodiment joining clip 2 is made of steel wire. For use with insulated concrete forms incorporating a welded wire tie, joining clip 2 can be made of a wire of approximately the same nominal diameter as the welded wire tie. It may be seen, however, that the joining clip 2 may be made of a smaller or larger diameter wire, so long as it provides sufficient structural integrity.

As shown in FIG. 1, the joining clip 2 is a formed or bent steel wire, shaped generally in a "U" shape such that the clip has two independent legs 4, 4'. The hooks 6, 6' shown on each leg of the joining clip (depicted on the left side of the joining clip in FIG. 1) are bent at some angle less than about 90°, being an acute angle, such as about a 45° to 75° angle. By this means, the hooks may be securely fastened about a wire tie 12 in an insulated concrete form 10. The other end 8 of the clip is bent into a configuration such that it "locks" or "snaps" about a wire tie 12; that is, it also is bent at some angle less than about 90°. FIGS. 2 and 3 show the same joining clips in different orientations, such that all aspects of are shown.

While the joining clip 2 as illustrated in FIGS. 1 to 5 is made of wire, it is to be appreciated that the joining clip could be made of a metal with other than a circular cross-section. Thus square or rectangular cross-section stock could also be employed. The joining clip may be ordinary steel, such as mild steel, or may be made of other alloys. The joining clip may also have a coating, to inhibit oxidation or for other purposes, such as a galvanized joining clip.

Applicant has found that a two-legged joining clip offers advantages over, for example, a one legged joining means, such as might be obtained simply by use of a single strand of wire fastened into a hook at each end. First, the two-legged joining clip offers increased strength and stability, and prevents displacement of the insulated concrete forms. Second, as will be apparent by FIGS. 5 and 7, use of the two-legged joining clip provides a rectangular enclosed area which may be employed to advantage to secure reinforcing rods, such as rebar. That is, rebar may be horizontally disposed within the rectangle formed by legs 4, 4' of a vertical clip 2 and horizontal wires of ties 12. Similarly, rebar may be vertically disposed within a rectangle formed by legs 4, 4' of clip 2 joining together two ties in a horizontal

orientation, with the remaining sides of the rectangle defined by a portion of ties **12**. A two-legged joining clip is thus a preferred embodiment, but any joining clip is included within the scope of the invention. For example, it is possible that the joining clip be essentially a strap, optionally with a hole or opening therein to secure reinforcing rods in the desired configuration.

5 FIGS. 4 and 5 show joining clip **2** joining forms in a horizontal and vertical orientation, respectively. In FIG. 6 a straight form **10** is joined to an angled form by means of joining clip **2**. As is seen in FIG. 4, joining clip **2** forms, in part, a rectangular enclosed area through which rebar may be placed and secured. It is to be appreciated that any appropriately constructed forms may be so joined, so that, for example, angled or straight forms may be joined in any combination. In FIG. 5 two stacked
10 forms **10** are joined by means of joining clip **2**. Here also, a rectangular enclosed area results for secure placement of horizontally placed rebar within the center of a concrete beam, as depicted in FIG. 5. While FIG. 5 shows two forms that are placed such that the ends form a single plane, it is to be appreciated that the joining clip may similarly be employed where forms **14** are staggered one over the other, such that the ends do not form a single plane, so long as metal ties **12** form a plane. Given the
15 placement of metal ties in the forms of FIGS. 4 through 8, it is to be appreciated that at discrete intervals the metal ties of forms stacked above each other will form a continuous plane. The forms must be so placed in order to have the desired resulting concrete posts in the waffle grid forms.

It is further to be appreciated that joining clips may be employed in both a horizontal and vertical direction from a single metal tie **12**, as shown in FIG. 6. Thus the joining clips may be employed such
20 as to secure three or four forms in both a horizontal and vertical direction, such as to form a rigid and joined panel.

It is further to be understood that while this invention is described in terms of expanded polystyrene forms made by American Polysteel, LLC, other insulating concrete forms, including forms made with any plastic or other material that can be suitably molded and provide desired insulating
25 properties may be employed. The use of related polymeric materials for insulation and similar applications is known in the art. It is further to be understood that while this invention is described in terms of insulating concrete forms employing welded steel ties, the joining clips of this invention may be employed with forms having other types of ties. It may be necessary, and is contemplated by this

invention, that the joining clips will be modified to join with the type of tie employed in the desired form. Thus different engagement means may be provided, different materials may be used, or different length joining clips may be employed, all within the contemplation of this invention.

One advantage of American Polysteel, LLC forms as described herein is that the distance from
5 the top edge of the form tie to the top edge of the form, and the distance from the bottom edge of the form tie to the bottom edge of the form, is constant regardless of the height of the form. Thus a single dimensioned joining clip may be employed for all forms of a given style, such as the American Polysteel PS-3000 Series waffle grid forms, regardless of the dimensions of such forms. Similarly, the vertical distance between the bottom of a tie on a first form to the top of the coplanar tie on a form disposed
10 immediately below the first form is the same as the distance between two immediately adjacent ties in horizontally adjacent forms. Thus one size or length of joining clip may be used for either or both horizontal and vertical joining, as shown in FIG. 7, and may be employed with any form (straight, corner, etc.) properly dimensioned in terms of positioning of the tie relative to the edge.

The joining clip of this invention permits any number of forms to be tied together into a single
15 "unitized" structure without the use of glues or adhesives, and thus offers a number of advantages. Use of the joining clips provides for positive connection between insulating concrete forms, both vertically and/or horizontally. The joining clips further allow for easy interconnection of forms to create panels. Panelization increases efficiency of installation on site. This is particularly useful in areas with more severe winter weather. Panels can be assembled in a warehouse or other setting under controlled
20 conditions, and transported to a job site for installations, rather than employing site-specific wall construction. Panels can also be changed with no waste of material.

Rigidly locking forms together by means of joining clips facilitates creating a plumb, square, and level first course of forms when beginning a project. The joining clips further provide a discrete space within which to capture and restrain reinforcing rod, commonly known as rebar, all within a specific and
25 specified area, thereby meeting engineering or code specifications.

In one embodiment, joining clips can be employed to secure forms to each other for transport to job sites. This allows for securing a number of forms into a larger more easily secured unit for transportation, such as on a truck, and/or for storage. Such forms may be "unclipped" at the job site as

needed, or if appropriate the larger panel created by use of joining clips may be employed for wall construction. Use of joining clips further allows for easy disassembly of panels for changes to the structure prior to concrete placement. Use of glue or other joining means does not permit disassembly. This further allows for disassembly of transported forms to be reassembled to create a desired structure.

- 5 Thus the use of joining clips eliminates the need for glue or other mechanical means of preventing forms from "floating" or separating during the concrete placement process due to the pressure of concrete on the inside of forms.

The joining clips are further more economical than use of glue or adhesive as a means of securing forms before concrete placement, both in terms of cost of the joining means (joining clips
10 versus glue or adhesive) and cost of labor.

The invention disclosed herein further includes panelized units made of more than one insulated concrete form joined together by means of joining clips, and preferably panelized units made of more than one form wherein such forms are joined together in both a horizontal and vertical direction by means of joining clips.

- 15 Although the invention has been described in detail with particular reference to these preferred embodiments, other embodiments can achieve the same results. Variations and modifications of the present invention will be obvious to those skilled in the art and it is intended to cover all such modifications and equivalents. The entire disclosures of all references, applications, patents, and publications cited above, and of the corresponding application(s), are hereby incorporated by reference.